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(54) Food or beverage cans made from plastic coated steel sheet.

(57) The use of organic solvent-based coating compositions in the preparation of coated steel feedstock for use in the manufacture of retortable draw-redraw food and beverage cans is eliminated by using as such can feedstock a laminated or extrusion coated steel sheet comprising a steel sheet material (e.g., such as electrolytic chrome/chrome oxide coated steel) having adhered to at least one major planar surface thereof a multi-layered synthetic thermoplastic resin coating comprising (1) an adhesive synthetic thermoplastic resin inner layer (e.g., such as a layer of a normally solid random ethylene/acrylic acid copolymer) bonded directly to the surface of said steel sheet material and (2) an outer layer of a synthetic thermoplastic polymer resin which has a crystalline melting point of at least about 121°C and which is adhered to said adhesive resin inner layer.

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Metallic food and beverage cans and method of manufacturing the same by a draw-redraw forming process from plastic coated steel sheet material.

TITLE MODIFIED  
see front page

The present invention relates to the manufacture of metallic food and beverage cans and more particularly to the manufacture of 2-piece cans via a draw-redraw metal forming process. In another aspect, 5 the present invention relates to the use of an extrusion coated or film laminated plastic/metal/plastic laminate as the can body feed stock in a draw-redraw steel can forming process.

Metallic cans of various types and sizes find 10 widespread commercial use in the packaging of a wide variety of foods and beverages. In such food and beverage packaging usage, it is generally desired to avoid direct contact between the food or beverage to be packaged and the metallic substance from which the 15 container is manufactured. To that end, metallic cans for food and beverage packaging are typically coated on at least their interior surfaces with a coating of a relatively inert organic substance.

Historically, such organic can coatings were 20 typically deposited or applied from relatively low

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solids organic solvent-based solutions. However, in more recent times, environmental concerns and regulations requiring substantial reductions in airborne emissions from various industrial facilities have prompted a need  
5 for can coatings and can coating processes involving substantially less organic solvent usage (and thus substantially less potential for undesired airborne organic solvent emissions) than is normally encountered with the use of said low solids content organic solvent-  
10 -based solutions.

In response to the aforementioned environmental concerns and the attendant need for reduced solvent emission, certain waterborne can coating compositions and high solids organic solvent-based can  
15 coating compositions have been developed. While such waterborne and high solids organic systems appear to be potentially suitable for use in connection with certain types of can manufacturing operations (e.g., as coatings in the manufacture of 3-piece rolled and seamed cans  
20 and in coating the exterior and/or interior surface of pre-formed aluminum and/or steel cans made by the draw and iron can forming process), they are not generally satisfactory for use in connection with draw-redraw can forming processes in which the coating employed on the  
25 pre-coated steel can stock is required to withstand the rather severe mechanical stresses involved in the can body forming operation. Moreover, even the organic solvent or plasticizer-based polyvinyl chloride, epoxy and epoxy phenolic systems conventionally employed to  
30 prepare can sheet or can coil stock for use in draw-redraw can forming operations are somewhat limited in terms of the maximum depth to diameter draw ratio (or severity of draw) which can be tolerated without coating failure.

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In view of the foregoing, it is an object of  
the present invention to provide an improvement in the  
manufacture of steel food or beverage cans by the  
draw-redraw process whereby the use of organic solvent-  
based coatings for the steel feed stock can be eliminated.  
In addition, it is also an object of this invention to  
provide a means by which retortable draw-redraw containers  
can be manufactured from film laminated or extrusion  
coated steel sheet material while still maintaining  
equal or greater depth to diameter of draw ratio capability  
relative to that currently possible using the conventional  
organic solvent or plasticizer based coating technology.

The term "retortable" as herein used is  
typically applied to containers filled with a food  
product or a beverage which is sterilized and processed  
by immersion of the filled containers in a hot bath  
maintained at an elevated temperature of about 121°C  
for a prolonged period of time such as, for example, an  
hour or longer.

These and other objects are achieved in  
accordance with the present invention by the use, as  
the coated steel feedstock in a draw-redraw process for  
the manufacture of steel food or beverage can bodies,  
of a laminated or extrusion coated steel sheet having  
adhered to at least one major planar surface thereof a  
multilayered synthetic thermoplastic resin coating  
comprising (1) an adhesive synthetic thermoplastic  
resin inner layer which comprises at least a major  
proportion of a normally solid random copolymer of  
ethylene with from 1 to 30 weight percent, based upon  
such copolymer, of an ethylenically unsaturated car-  
boxylic acid comonomer and which is bonded directly to

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the surface of said steel sheet and (2) an outer layer of a synthetic thermoplastic polymer resin which has a crystalline melting point of 121°C or more and which is adhered to said adhesive resin inner layer.

5           Moreover, in those instances where film lamination or extrusion coating is employed for both major planar surfaces of the steel sheet material, the invention permits the preparation of retortable plastic coated draw-redraw beverage and food cans totally  
10          without the use of organic solvent or plasticizer based coating systems. Further, the invention is especially beneficial in that it facilitates the preparation of retortable draw-redraw cans having draw ratio capabilities (i.e., depth to diameter draw ratio capabilities) at  
15          least comparable to that obtained with coated steel can sheet stock prepared using the conventional organic solvent or plasticizer based canstock coating systems. In addition, the laminates employed can sometimes obviate the use of the external drawing lubricants  
20          which are typically employed in the subject draw-redraw can forming process.

Steel sheet materials suitably employed in the practice of the present invention include any steel sheet materials which exhibit good adhesion to the  
25          adhesive synthetic thermoplastic inner layer which is directly bonded thereto. Examples of such steel sheet materials include those types of chemically or electro-chemically coated (e.g., electrolytically plated) steel sheetstocks already known in the art to be useful in  
30          the manufacture of food and beverage containers. Preferably, the steel sheet material employed herein is a non-ferrous metal coated steel sheet such as chromium/-chromium oxide coated steel (also commonly referred to

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in the art as chrome/chrome oxide coated steel, tin-free steel and as electrolytically chrome coated steel or "ECCS") which bears a composite coating of chrome and chrome oxide on both major planar surfaces of said  
5 steel sheet and various species or versions of which are well known in the art.

The thickness of the steel sheet employed in the practice of the present invention corresponds to that employed in conventional draw-redraw can manufacturing operations and is typically in the range of from 5 to 15 mils. Preferably, such thickness is in  
10 the range of from 7 to 10 mils.

The adhesive synthetic thermoplastic resin employed to form the innermost layer of the above-noted  
15 multilayered synthetic thermoplastic resin coating (i.e., the layer directly bonded to the surface of the steel sheet material employed) comprises at least a major proportion of a normally solid random copolymer of ethylene with from 1 to 30 weight percent, based  
20 upon such copolymer, of an ethylenically unsaturated carboxylic acid monomer. Preferably, such adhesive synthetic thermoplastic resin exhibits an initial 90° peel strength at ambient temperature (i.e., 25°C) of at least 2.7 kg/cm (preferably at least 3.58 and most  
25 preferably at least 4.5 kg/cm) when measured by ASTM D 1876 in the form of a steel/adhesive layer/steel sandwich construction in which each steel layer has a thickness of 6 mils.

Examples of resins suitably employed as the  
30 major component of the aforementioned adhesive resin inner layers in the practice of the present invention

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include normally solid random copolymers of a major proportion of ethylene with from 1 to 30 (preferably from 2 to 20) weight percent, based upon such copolymer of an ethylenically unsaturated carboxylic acid monomer  
5 such as, for example, ethylenically unsaturated mono- or polybasic carboxylic acids per se (e.g., acrylic acid, methacrylic acid, crotonic acid, fumaric acid, maleic acid, itaconic acid, etc.); partial esters of polybasic ethylenically unsaturated acids (e.g., mono-  
10 methyl maleate, monoethyl maleate, monomethyl fumarate, monoethyl fumarate, tripropylene glycol monomethyl ether acid maleate, ethylene glycol monophenol ether acid maleate, etc.); polybasic ethylenically unsaturated carboxylic acid anhydrides (e.g., maleic anhydride, etc.) and the like. In addition, partially neutralized versions of the aforementioned carboxylic acid containing polymers, generally referred to in the art as ionomers, can also be suitably employed. Further, the foregoing adhesive resins can consist essentially of  
15 20 ethylene and the aforementioned ethylenically unsaturated carboxylic acid monomers or can further contain a minor amount (e.g., up to about 20 weight percent) of other types of monomers copolymerizable therewith such as, for example, esters of acrylic acid and the like.

25 Preferably, the adhesive resin employed as the major component in the aforementioned adhesive layer may optionally further include a minor proportion (e.g., up to about 20 percent) of other copolymerizable monomers such as, for example, lower alkanol esters of acrylic or methacrylic acid. The thickness of each of the individual adhesive resin inner layers on the plastic coated steel sheets used in the practice of the present invention is typically in the range of from 0.1 to 1.4 mils (preferably from 0.2 to 0.8 mil).

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As has been noted, each of the outer layers in the aforementioned multilayered thermoplastic resin coatings is composed of a synthetic thermoplastic resin which has a crystalline melting point of 121°C or more.

5 Preferably, the crystalline melting point of such synthetic thermoplastic resin is greater than 121°C. This feature is important in order that the layer composed of such resin does not become a flowable melt under the conditions employed in the food processing

10 operation but instead maintains its integrity as a protective coating layer during such processing. In addition, it is also important that the synthetic thermoplastic resin employed in such layer be relatively gouge or damage resistant (at least at ambient temperatures and both before and after exposure to steam and/or grease at 121°C). The resin should also be relatively inert or impervious to water, grease and the various foodstuffs and/or beverages to be ultimately packaged in the subject draw-redraw cans both at the

15 elevated temperatures typically employed during the post-canning processing operations (e.g., in retorting operations) and at the ambient temperatures encountered during storage pending final consumption of such food or beverage contents. Further, it is also important

20 that the thermoplastic resin employed in such outer resin layer possess (a) sufficient strength and toughness to withstand the rather severe stresses imparted thereto during formation of the draw-redraw can body from the instant plastic/metal/plastic

25 laminates as well as (b) sufficient adhesiveness to the above-described adhesive resin inner layer to prevent delamination therefrom during such can forming operation and during the subsequent food or beverage canning and/or processing operations.

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Examples of synthetic thermoplastic resins suitable for use in the aforementioned  $\geq 121^{\circ}\text{C}$  melting point outer layers include high density polyethylene (e.g., having a density in the range of from 0.950 to 5 0.965 and a melt index in the range of from 0.05 to about 5), polypropylene, polyamides, polyesters, ethylene/propylene copolymers and the like. Further, blends of these  $\geq 121^{\circ}\text{C}$  melting point resins with resins of lower melting points (e.g., low density polyethylene, 10 ethylene/acrylate copolymers, ethylene/vinyl acetate copolymers, random ethylene/acrylic or methacrylic acid copolymers, ionomers, chlorinated polyethylene, etc.) can also be employed so long as the effective melting point of the resulting blend remains at above about 15 121 $^{\circ}\text{C}$ . Indeed, in those instances where high density polyethylene resin is employed as the predominant component of the outer resin layer, it has been found to be especially advantageous to employ a blend of such high density polyethylene with up to about 30 weight percent, based upon the blend weight, of a low density polyethylene therein. Resins which are particularly preferred for use as the outermost coating layers include high density polyethylene having densities of 20 from 0.960 to 0.965 g/cc and melt indexes of from 0.05 to 3, blends of such high density polyethylenes with up to about 30 weight percent of low density polyethylene, and polyamide resins such as nylon 6, nylon 6/9 and 25 nylon 6/12.

The thickness of each of the outer resin 30 layers is typically from 0.1 to 1.4 mils (preferably from 0.2 to 0.8 mil).

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In coating operations, the inner and outer layers can be applied separately or simultaneously either by coextrusion or by lamination of a previously prepared multilayered film.

5        Preferably, the individual layers of the multilayered plastic coatings are applied simultaneously by either coextrusion or multilayer film lamination techniques. However, in an alternative embodiment, it is also possible to arrive at the desired type of  
10      multilayer plastic coated can stock without the use of organic solvent-based coating systems by first applying the adhesive synthetic thermoplastic resin inner layers to the steel substrate from an aqueous dispersion of such resin (e.g., such as the ammoniated aqueous dispersions described in U.S. Patent 3,799,901) and thereafter applying the  $\geq 121^{\circ}\text{C}$  melting point resin outer layers to the exposed surfaces of the adhesive resin inner layers via either extrusion coating or film lamination techniques.

20        Regardless of how the above-noted multilayered coatings are applied, it is generally preferable to subject the resulting laminate to a post-heating treatment prior to the can forming draw-redraw step at a temperature above the crystalline melting point of the highest  
25      melting resin employed in said multilayered coating for a short period of time such as, for example, for a period of 5 minutes or less. The post-heating procedure is generally conducted at a temperature of from  $149^{\circ}$  to  $260^{\circ}\text{C}$  and for a period of time of from 0.2 to 5 minutes.

30        The use of the hereinbefore described multi-layer plastic coated can stock in the actual can forming

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operations is conducted generally pursuant to conventional draw-redraw can forming techniques and, naturally, such operation can consist of either a single draw or multiple drawing steps depending upon the ultimate depth of draw 5 (or draw ratio) required for the particular type of can to be formed in such operation.

The formation of can bodies (especially deeply drawn can bodies) by the draw-redraw forming process imparts a high degree of stress to the container 10 stock employed and a significant amount of unrelieved residual stress can remain in the plastic coating employed on such container stock following can body formation therefrom. It is therefore important in the practice of the present invention that the multilayer 15 plastic coating employed has sufficient strength and adhesion at ambient temperatures to withstand such residual stresses without coating failure during ambient temperature storage of foods and beverages therein. In addition, since food and/or beverage canning operations 20 often involve processing at elevated temperatures (e.g., such as steam processing at about 121°C) for prolonged periods of time (e.g., as much as an hour or more), it is similarly important that the multilayered plastic coating employed have sufficient strength and 25 adhesion to avoid coating failure under such elevated temperatures.

In the case of the hereinbefore described random ethylene/carboxylic acid copolymer adhesive resins, it has been found that, while such resins exhibit 30 adequate ambient temperature (e.g., normal room temperature of 20° to 25°C) strength properties to generally withstand the aforementioned residual stresses, the

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strength properties of such resins are not normally sufficient to withstand such residual stresses at the elevated temperatures (e.g., usually about 121°C) normally employed in food or beverage canning or processing operations. Fortunately, however, it has also been found that the can bodies formed by the draw-redraw process from the above-described multilayered plastic coated steel sheet material (i.e., using the indicated adhesive resin inner layers therein) can be caused to successfully withstand the aforementioned type of elevated temperature canning and/or processing operations by relieving the aforementioned residual stresses (i.e., those residing in the multilayered coating after draw-redraw can body formation) by subjecting the can body, after its formation but prior to any food or beverage filling and processing operations, to a temperature above the crystalline melting point of the highest melting point resin employed in said multilayered coating for a time sufficient to relieve the stresses created in such coating during the can body formation. Typically, when such stress-relieving step is conducted in a hot air oven, the oven temperature will be in the range of from 149° to 260°C preferably from 191° to 232°C and the can bodies to be treated will have a residence time in said oven of from 0.2 to 5 minutes (preferably about 1 minute or so). On the other hand, when more rapid heating means are employed, such as, for example, induction heating techniques, much shorter heating cycles such as, for example, on the order of only a few seconds or so can be sufficient to raise the temperature of the multilayered coating to a level above the crystalline melting point of the highest melting point component thereof.

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Alternatively, the multilayered coating or coatings may be subjected, either prior to, during or subsequent to the application thereof to the steel sheet material, to an electron beam irradiation dosage of from 2 to 20 megarads.

The elevated temperature strength and/or viscoelastic properties of such coatings are sufficiently enhanced to meet the above-noted elevated temperature (e.g., retorting temperature) performance requirements in view of the crosslinking of the resins via the use of such conventional high energy electron beam irradiation techniques. Such electron beam irradiation crosslinking treatment can be suitably performed in the practice of the present invention either prior to (e.g., in free single or multilayered plastic film form) or subsequent to the application of the instant multilayered thermoplastic resin coating to the steel substrate as well as (though less preferably) after formation of the can body from the coated steel sheet material.

In the aforementioned irradiation treatment of such free films or plastic/metal/plastic laminate sheet material (or the can bodies formed therefrom), a total radiation dosage of from 2 to 20, preferably from 5 to 10, megarads has been found to typically be satisfactory for the purposes of the present invention.

Another feature to note in the practice of the present invention is that the interlayer adhesion between the outer layer and its corresponding adhesive resin inner layer can be a determining factor in the ability of the overall multilayer structure to withstand

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the rather severe stresses imparted during draw-redraw can body formation and/or any residual stress remaining during the subsequent canning/processing operations.

In some cases (i.e., in the case of a high density polyethylene or nylon outer layer and the aforementioned random ethylene/ethylenically unsaturated carboxylic acid copolymer inner layers) the direct adhesion between such layers has been found to generally be sufficient to withstand such stresses. However, in any cases where the direct adhesion between such layers is not alone sufficient to withstand the indicated stresses, it may be necessary or desirable to employ an intermediate adhesive or compatibilizing layer of a third thermoplastic resin (or of a resin blend) which exhibits good adhesion to both of the resins employed, respectively, in the outer and inner layers of the coating.

The practice of the present invention is further illustrated by reference to the following examples.

20    Examples 1 and 2

In these examples, 2 different multilayered plastic/chrome-chrome oxide coated steel/multilayered plastic laminates are prepared by laminating a previously prepared multilayered plastic film to both sides of a 7.5 mil thick chrome-chrome oxide coated steel sheet. The lamination is conducted by preheating the steel sheet to about 204°C and passing said preheated steel sheet through closed nips already threaded with the two multilayered films and by then post-heating the so-formed laminate in a hot air oven at an elevated temperature (i.e., 204°C for Example 1 and about 221°C

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for Example 2) for 5 minutes. The resulting laminate is then formed into a 307 x 303 size can body via a draw-redraw operation and the resulting can body is thereafter post-baked for about 1 minute in a hot air  
5 oven maintained at a temperature of about 204°C in the case of Example 1 and at about 221°C in the case of Example 2, and is subsequently (i.e., after cooling to room temperature) subjected to a grease and steam resistance testing by filling the can body with grease  
10 (i.e., lard) and exposing the filled can to a temperature of 121°C for 1 hour and by exposure to steam in an autoclave at 121°C for 1 hour. The multilayered film employed in the individual examples, and the steam and grease resistance results for the resulting cans formed  
15 from laminates made therewith, are summarized in Table 1, below.

For comparative purposes, two additional runs (i.e., Controls 1 and 2) are made in the same fashion (i.e., using the same plastic/steel/plastic laminates  
20 as in Examples 1 and 2, respectively) except that the indicated post-baking of the formed can bodies is eliminated.

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TABLE 1

Example No.	Inner Adhesive Layer		>121°C Melting Point Outer Layer		Grease Test	Steam Test
	Type	Thickness	Type	Thickness		
1 <sup>4</sup>	E/AA <sup>2</sup>	0.3 mil	HDPE <sup>1</sup>	0.7 mil	PASSED	PASSED
2 <sup>5</sup>	E/AA <sup>2</sup>	0.7 mil	Nylon <sup>3</sup>	0.3 mil	PASSED	PASSED
Control 1*	E/AA <sup>2</sup>	0.3 mil	HDPE <sup>1</sup>	0.7 mil	FAILED	FAILED
Control 2*	E/AA <sup>2</sup>	0.7 mil	Nylon <sup>3</sup>	0.3 mil	FAILED	FAILED

- 1 High density polyethylene (density = 0.965 g/cc and melt index = 0.7).
  - 2 Random copolymer of ethylene with 6.5 weight percent acrylic acid having a melt index of 5.5.
  - 3 Nylon 6 supplied by Allied Chemical Co. under the trade name of capron® 8207 (melting point of 216°C and melt index at 235°C of 4.6).
  - 4 Can body subjected to post-baking operation for about 1 minute in a hot air oven and at about 204°C subsequent to its formation but prior to steam and grease resistance testing.
  - 5 Can body subjected to post-baking operation for about 1 minute in a hot air oven at about 221°C subsequent to its formation but prior to steam and grease resistance testing.
- \* Not an example of the invention.
- ® Trademark

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Examples 3 and 4

Two additional multilayered plastic/chrome-chrome oxide coated steel/multilayered plastic laminates were prepared in accordance with the procedure of Examples 1 and 2, except that following the post-heating treatment, each of the laminates was irradiated on each side with a total per-side irradiation dosage of 5 megarads of high energy electron beam irradiation. Thereafter, the resulting irradiated laminate was formed into a 307 x 10 303 size can body via the same draw-redraw operation as in Examples 1 and 2 and the resulting can body was subjected to the same grease and steam resistance test. The multilayered film employed in Examples 3 and 4, and the steam and grease resistance results for the resulting cans formed from laminates made therewith, are summarized 15 in Table II, below.

In addition to the laminates of Examples 3 and 4, a comparative laminate (i.e., Control 3) was prepared corresponding to the Example 3 laminate except that the electron beam irradiation treatment was eliminated. The grease and steam resistance results for a 307 x 303 can body formed from the Control 3 laminate are also summarized in Table II.

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TABLE II

Example No.	Inner Adhesive Layer		>121°C Melting Point Outer Layer		Grease Test	Steam Test
	Type	Thickness	Type	Thickness		
3 <sup>4</sup>	E/AA <sup>2</sup>	0.3 mil	HDPE <sup>1</sup>	0.7 mil	PASSED	PASSED
4 <sup>4</sup>	E/AA <sup>2</sup>	0.7 mil	Nylon <sup>3</sup>	0.3 mil	PASSED	PASSED
Control 3*	E/AA <sup>2</sup>	0.3 mil	HDPE <sup>1</sup>	0.7 mil	FAILED	FAILED

1 High density polyethylene (density = 0.965 g/cc, melt index = 0.7, and melting point = 135°C).

2 Random copolymer of ethylene with 6.5 weight percent acrylic acid having a melt index of 5.5.

3 Nylon 6 supplied by Allied Chemical Co. under the trade name of Capron® 8207 (melting point of 216°C and melt index at 235°C of 4.6).

4 Plastic/metal/plastic laminated sheet stock exposed on each side to 5 megarads of electron beam irradiation after formation but prior to can body formation.

\* Not an example of the invention.

® Trademark

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Example 5

The procedure of Example 4 was repeated except that the plastic coated steel sheet was irradiated on each side with a 10 megarad dosage instead of 5 as in 5 Example 4. The steam and grease resistance results for cans formed from the indicated irradiated laminate are summarized in Table III, below.

In addition, a comparative run (Control 4) is also made in the same fashion and using the same 2-layer 10 plastic film except that irradiation treatment of the resulting plastic/steel laminate is eliminated. The results for this comparative run are also summarized in Table III, below.

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TABLE III

<u>Example No.</u>	<u>Multilayered Film Employed</u>	<u>Grease Test</u>	<u>Steam Test</u>
5	0.3 mil CAPRON® 8207/0.7 mil EAA <sup>1</sup>	PASSED	PASSED

Control  
4\*

0.3 mil CAPRON® 8207/0.7 mil EAA

FAILED

FAILED

<sup>1</sup> Laminate exposed to 10 megarad of electron beam irradiation after its formation but prior to can body formation therefrom.

\* Not an example of the invention (no irradiation treatment).  
 CAPRON® 8207 = Nylon 6 supplied by Allied Chemical Co. having melting point of 216°C and melt index at 235°C of 4.6.

EAA = Random ethylene/acrylic acid copolymer (6.5% by weight acrylic acid) supplied by The Dow Chemical Co. (melting point = 100°C and melt index at 190°C = 5.5).

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CLAIMS

1. A drawn food or beverage container body which is made of a laminated or extrusion coated steel sheet comprising a steel sheet having adhered to at least one major surface thereof a multilayered synthetic thermoplastic resin coating comprising an adhesive synthetic thermoplastic resin inner layer which is composed of at least a major proportion of a normally solid random copolymer of ethylene with from 1 to 30 weight percent, based upon said copolymer, of an ethylenically unsaturated carboxylic acid monomer and which copolymer is bonded on one side directly to the surface of said steel sheet and is adhered on its other side to an outer layer of a synthetic thermoplastic polymer resin having a crystalline melting point of at least 15 about 121°C.

2. The container body of Claim 1, wherein the steel sheet is chrome/chrome oxide coated steel.

3. The container body of Claim 1 or 2, wherein the adhesive layer comprises a copolymer of a major 20 proportion of ethylene and from 2 to 20 weight percent, based upon the weight of such copolymer, of an ethylenically unsaturated carboxylic acid monomer.

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4. The container body of Claim 1, 2 or 3,  
wherein the outer layer comprises a high density poly-  
ethylene resin having a density of from 0.950 to 0.965  
g/cc and a melt index from 0.05 to 5 or a polyamide  
5 resin.

5. The container body of Claim 1, 2 or 3,  
wherein the outer layer comprises a blend of a high  
density polyethylene resin having a melt index of from  
0.05 to 3 and a density of from 0.960 to 0.965 g/cc  
10 with up to about 30 weight percent based upon the  
weight of such blend of a low density polyethylene  
resin.

6. The container body of Claim 1, 2 or 3,  
wherein the adhesive layer comprises a copolymer of a  
15 major proportion of ethylene with from 2 to 20 weight  
percent, based upon such copolymer, of acrylic or  
methacrylic acid, and wherein the outer layer comprises  
a high density polyethylene resin having melt index of  
3 or less and a density of at least about 0.960 or a  
20 polyamide resin.

7. The container body of any one of the  
preceding Claims, wherein the steel sheet material has a  
thickness of from 5 to 15 mils, and the multilayered  
synthetic thermoplastic resin coating has an overall  
25 thickness of from 0.2 to 2.8 mils.

8. The container body of any one of the  
preceding Claims, which has been post-baked after its  
formation but prior to its use in food or beverage  
canning operations at a temperature above the crystalline  
30 melting point of the highest melting point resin employed

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in said thermoplastic resin coating for a period of time sufficient to relieve the stress created in such coating during the formation of said can body.

5 9. The container body of any one of Claims 1 to 7, having been exposed to an electron beam irradiation dosage of from 2 to 20 megarads.

10 10. A container comprising the container body of any one of the preceding Claims, and a food or beverage hermetically contained within the container body.

15 11. A method for forming a food or beverage container body, comprising the steps of adhering to at least one planar surface of a steel sheet material the multilayered synthetic thermoplastic resin coating of any one of Claims 1 to 7, forming the resulting coated steel sheet material into said container body via a draw-redraw container forming process, post-baking the coated container body formed by said draw-redraw process at a temperature above the crystalline melting point of the highest melting point resin employed in said thermoplastic resin coating for a period of time sufficient to relieve the stress created in such coating during the formation of said can body.

20 12. The method of Claim 11, wherein post-baking of the formed container body takes place in a hot air oven maintained at a temperature of from 149° to 260°C for a period of from 0.2 to 5 minutes prior to its use in food or beverage canning operations.

25 13. A method for forming a food or beverage container body, comprising the steps of adhering to at

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least one planar surface of a steel sheet material the multilayered synthetic thermoplastic resin coating of any one of Claims 1 to 7, exposing the coating to an electron beam irradiation dosage of from 2 to 20 megarads  
5 either prior to, during or subsequent to, the application of such coatings to said steel sheet material, and forming the resulting coated steel sheet material into said container body via a draw-redraw container forming process.

10           14. The process of Claim 13, wherein the electron beam irradiation dosage employed is from 5 to 10 megarads.

15           15. The process of Claim 13 or 14, wherein the electron beam irradiation of the coating is conducted prior to the draw-redraw formation of the food or beverage can body from the laminated or extrusion coated steel sheet.

20           16. The process of Claim 13 or 14, wherein the electron beam irradiation is conducted on the coating in free film form prior to the application of such coating to the steel sheet material.

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25           17. A method of making draw-redraw food or beverage can bodies comprising the steps of extrusion coating or laminating to both sides of a steel sheet material the multilayered synthetic thermoplastic coating of any one of Claims 1 to 7, irradiating both multilayered thermoplastic coatings either prior, during, or subsequent to the application thereof to the steel sheet material with an electron beam irradiation dosage of from 2 to 20 megarads; and forming the coated metal sheet into a container body via a draw-redraw can forming process.  
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European Patent  
Office

EUROPEAN SEARCH REPORT

0062385  
Application number

EP 82 20 0410

DOCUMENTS CONSIDERED TO BE RELEVANT						
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. *)			
Y	<p>---</p> <p>EP-A-0 019 835 (THE DOW CHEMICAL)            *Claims 1-3,9-19,22,23; page 3, line 19 - page 10, line 10; page 11, line 19 - page 12, line 15; page 13, line 25 - page 14, line 4; examples 1-14,20; table 1*</p> <p>---</p> <p>GB-A-2 008 492 (JAPAN CROWN CORK)            *Claims 1,2; page 1, line 60 - page 4, line 65; page 6, lines 2-14; page 7, line 17 - page 8, line 39; page 10, example 1*</p> <p>---</p> <p>GB-A-1 394 883 (THE DOW CHEMICAL)            *Claims 1,4,5,9-11; page 1, line 47 - page 2, line 106; page 3, line 79 - page 4, line 43*</p> <p>---</p> <p>US-A-3 750 827 (H.WICK)            *The whole document*</p> <p>-----</p>	1-9,11 -16	B 32 B 15/08 B 65 D 1/28 B 65 D 25/14			
A		1,3,6	TECHNICAL FIELDS SEARCHED (Int. Cl. *)			
A		1,11; 13,17	B 32 B B 65 D			
<p>The present search report has been drawn up for all claims.</p> <table border="1"> <tr> <td>Place of search <b>THE HAGUE</b></td> <td>Date of completion of the search <b>04-03-1983</b></td> <td>Examiner <b>BLASBAND I.</b></td> </tr> </table> <p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone            Y : particularly relevant if combined with another document of the same category            A : technological background            O : non-written disclosure            P : intermediate document</p> <p>T : theory or principle underlying the invention            E : earlier patent document, but published on, or after the filing date            D : document cited in the application            L : document cited for other reasons            &amp; : member of the same patent family, corresponding document</p>				Place of search <b>THE HAGUE</b>	Date of completion of the search <b>04-03-1983</b>	Examiner <b>BLASBAND I.</b>
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